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Growth and yield of *rabi* castor as influenced by INM grown on *Vertic Ustrochrepts* of South Gujarat

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ABSTRACT

A field experiment was conducted at College Farm, Navsari Agricultural University, Navsari, (Gujarat-India) during *rabi* 2004-2005 to study the effect of integrated nutrient management (INM) in *rabi* castor (GCH-4). The plant height, number of branches/plant, length of spike, number of capsules/spikes, yield of seeds and stalk were recorded significantly higher over control due to application of 5 t bio compost/ha along with 100 per cent RDF, however, higher number of spikes/plant was observed with application of 5 t bio compost along with 75 per cent RDF.

Key words : INM, organic manure, fertilizers, growth, yield, castor

Oil seed crops have a unique significance in recent era of energy crisis as they play pivotal role in the agricultural industry and export trade of India. Castor holds first position among the non-edible oilseeds and occupies 38 and 36 per cent production and area, respectively in India. The integrated management of plant nutrient resources through the judicious use of organic, inorganic and bio-fertilizers offer an opportunity to sustain agriculture along with minimizing any soil and environmental damage. On the contrary, it has been clearly evidenced that the balanced and integrated nutrient management improves the soil organic matter content as well as soil quality which is an index of better soil health and sustainability of the system (Nambiar and Ghosh, 1989; Katyal, 1992 and Rajendra Prasad, 2000). However, the quantification of growth and yield attributes as well as yield of *rabi* castor under South Gujarat condition has not been studied so far, hence, the present study was planned to assess the impact of Integrated Nutrient Management on growth and yield of *rabi* castor.

MATERIALS AND METHODS

A field experiment was conducted during the *rabi* season 2004-05 at College Farm, NAU, Navsari (Gujarat-India), situated at 21° 07' N latitude and 73° 40' E longitude, with an elevation of 10 m above mean sea-level to study The Integrated Nutrient Management (INM) on growth and yield of castor (GCH-4) in South Gujarat. The experiment was laid out in randomized block design with factorial concept (FRBD) with 16 treatments composed of 4 levels of fertilizers (F_0: No fertilizer, F_1: 50 % RDF, F_2: 75 % RDF, F_3: 100 % RDF) and 3 source of manures (M_0 – No organic manure, M_1 – Farm Yard Manure @ 5 t/ha, M_2 – Bio compost @ 5 t/ha, M_3 – Vermi compost @ 2 t/ha) and it was replicated thrice. The experimental soil is classified under the order 'Inceptisols' comprises members of fine, montmorillonitic, isohyperthemic family of *Vertic Ustrochrepts* and soil series Jalalpur. The color of dry soil is dark brown and texture is clay and neutral to slightly alkaline in reaction. The experimental soil was low in available N, medium in available P_2O_5 and high in available K_2O with slight problem of excess soluble salts and compactness due to the puddling for *kharif* rice crop. Statistical analysis was carried out as per the methods described by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

The mean data of growth and yield attributes as well as yield of castor as influenced by different levels of inorganic fertilizers, source of organic manures and their interactions are presented in Table 1.

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Table 1 Effect of INM on growth parameters of castor crop

Treatments	Plant height (cm)					No. of branches/plant				
	M_0	M_1	M_2	M_3	Mean	M_0	M_1	M_2	M_3	Mean
F_0	78.33	102.40	106.60	125.67	103.25	6.07	6.73	7.60	6.73	6.78
F_1	120.40	143.53	123.40	113.13	125.12	6.53	6.40	8.33	7.67	7.23
F_2	101.67	126.13	168.47	124.27	130.13	7.00	9.53	13.13	12.00	10.41
F_3	123.20	128.67	170.33	146.27	142.12	9.26	14.60	15.06	14.80	13.43
Mean	105.90	125.18	142.20	127.33		7.21	9.31	11.03	10.30	
	S. Em. +		C.D. at 5 %			S. Em. +		C.D. at 5 %		
M	5.65		16.31			0.43		1.26		
F	5.65		16.31			0.43		1.26		
M x F	11.29		32.65			0.87		2.53		
C. V. %	15.63					16.03				

Table 2 Effect of INM on yield attributes of castor crop

Treatments	Length (cm) of main spike					Number of spikes/plant				
	M_0	M_1	M_2	M_3	Mean	M_1	M_1	M_2	M_3	Mean
F_0	27.73	26.87	27.13	25.73	26.87	7.13	6.80	6.27	6.80	6.75
F_1	28.33	28.40	29.13	29.00	28.72	6.60	7.20	7.47	7.67	7.23
F_2	31.33	30.60	38.87	38.80	34.90	7.07	8.93	14.13	8.93	9.77
F_3	32.87	44.27	46.87	41.60	41.40	7.47	11.53	8.33	11.73	9.77
Mean	30.07	32.53	35.50	33.78		7.07	8.62	9.05	8.78	
	S. Em. +		C.D. at 5 %			S. Em. +		C.D. at 5 %		
(M)	1.01		2.93			0.52		1.51		
(F)	1.01		2.93			0.52		1.51		
M x F	2.03		5.86			1.04		3.01		
C. V. %	10.65		21.56							
	Number of capsules per spike					Shelling percentage				
	M_0	M_1	M_2	M_3	Mean	M_0	M_1	M_2	M_3	Mean
F_0	22.13	21.27	28.47	25.53	24.35	46.6	57.8	60.4	59.5	56.1
F_1	23.47	30.60	30.73	35.00	29.95	46.3	59.3	58.9	55.5	55.0
F_2	28.67	34.33	37.87	40.07	35.23	52.5	58.7	59.2	61.9	58.1
F_3	28.60	45.03	48.47	44.67	41.69	60.8	63.3	66.8	62.8	63.4
Mean	25.72	32.81	36.38	36.32		51.6	59.8	61.4	59.9	
	S. Em. +		C.D. at 5 %			S. Em. +		C.D. at 5 %		
(M)	1.10		3.18			1.7		5.1		
(F)	1.10		3.18			1.7		5.1		
M x F	2.20		6.36			3.5		NS		
C. V. %	11.63					10.60				

The plant height (142.12 cm) and number of branches/ plant (15.06) were significantly higher with the application of 100 per cent RDF over control and 50 per cent RDF. It might be due to the fact that application of higher quantity of nitrogen and phosphorus might have accelerated the synthesis of chlorophyll and amino acids which are associated with major photosynthetic processes of plants. The results of the present investigation are in confirmation with those of earlier workers Thadoda (1996), Hans *et al.* (2001) and Sree and Reddy (2003). Significantly smaller plant (13.43 cm) and less number of branches (6.78) were recorded when no fertilizers were applied. The data further revealed that application of bio compost @ 5 t/ha (M_2) produced identical effects on plant height (142.20 cm) and number of branches/ plant (11.03) at harvest of the crop. The pronounced effect from bio compost over vermi compost was noted might be due to the higher rate of application, poor response of FYM might be due to the poor macro and micronutrient content. Application of bio compost might have created better soil condition due to the higher rate of application leading to better mobilization of bound nutrients and improvement in soil aggregates resulting in better root proliferation and thereby efficient absorption of water and nutrients. Secondly, the bio compost has a material which was predigested and also because of presence of pressmud which might have kept the pH of the soil low and thereby increased the availability of micronutrients. Significantly the lowest plant height (105.90 cm) and number of branches/plant (7.21) at harvest were recorded when organic manures were eliminated from the treatment. The interactions arising due to the sources of organic manure and levels of inorganic fertilizer significantly altered the growth parameters at the harvest of castor crop. The interaction M_2F_3 (100 % RDF + bio compost @ 5 t/ha) resulted taller plants (170.33) and more number of branches/plant (15.06). The shorter plants were produced when inorganic fertilizers were not applied along with any source of organic manures except, M_3F_0 (Table 1). The influence might be because of continuous supply of available nutrients from inorganic and organic sources on decomposition and due to the production of bio-active substances. The organic manures might have activated the certain growth characters due to the production of bio-active substances and higher fixation of N in the soil.

A perusal of the results presented in table 2 indicated that length of spike (41.40 cm), number of spikes/ plant (9.77), number of capsules/spike (41.69) and shelling percentage (63.4) were significantly higher with the application of 100 per cent RDF through inorganic fertilizers (F_3). This might be due to the increase in growth traits which helped to increase in synthesis of carbohydrates which was utilized for the development of crop. The data further indicated that application of organic manures significantly changed the length of spike (35.50 cm), number of spikes/plant (9.05), number of capsules/spike (36.38) and shelling

Table 3 Effect of INM on seed and stalk yield (kg/ha) of castor

Treatments	Seed					Stalk				
	M_0	M_1	M_2	M_3	Mean	M_0	M_1	M_2	M_3	Mean
F_0	1256.7	1241.5	1373.6	1345.3	1304.3	1083.8	1095.9	1116.6	1097.6	1098.5
F_1	1301.1	1339.8	1439.4	1291.6	1343.0	1144.2	1294.4	1303.0	1337.5	1269.8
F_2	1374.0	1584.5	1663.9	1390.7	1503.3	1270.2	1427.3	1479.1	1543.7	1430.1
F_3	1486.6	1731.2	2288.0	1485.3	1747.8	1348.1	1651.7	2121.7	1473.7	1648.8
Mean	1354.6	1474.3	1691.2	1378.2		1211.6	1367.3	1505.1	1363.1	
	S. Em. +		C.D. at 5 %			S. Em. +		C.D. at 5 %		
M	52.01		50.3			43.0		124.1		
F	52.0		150.3			43.0		124.1		
M x F	104.1		300.6			85.9		248.2		
C. V. %	12.20					10.90				

percentage (61.4) with the application of 5 t bio compost/ha (M_2). The interaction between organic manures and inorganic fertilizers (M x F) significantly changed the yield attributes of the crop (Table 2). Significantly higher length (46.87 cm) of spike, number of capsules/plant (48.47) and shelling percentage (66.8) were observed when 100 per cent RDF along with 5 t bio compost/ha (M_2F_3) were applied. While higher number of spikes/plant (14.13) was noted due to application of 75 per cent RDF along with 5 t bio compost/ha (M_2F_2) The scrutiny of results showed the supremacy of organic manures over its no application (M_0). The different organic manures failed to differentiate themselves so far the number of spikes/ plant was concerned.

Castor seed and stalk yield was significantly affected due to the different levels of inorganic fertilizers (Table 3). Application of 100 per cent RDF through inorganic fertilizers (F_3) significantly produced 34 per and 50 per cent higher seed and stalk yields of castor, respectively over control treatment (F_0). The 50 per cent RDF through inorganic fertilizers failed to increase the seed yield in the experiment might be due to the lack of translocation of these nutrients from vegetative parts to yield contributors or might be due to the short supply of nutrients. Similar results were also reported by Sree and Reddy (2003). Application of bio compost @ 5 t/ha produced more seed (1691.2 kg/ha) and stalk (1505.1 kg/ha) yield over control while vermi compost and FYM showed more or less similar yield over control. The results evidenced the supremacy of bio compost (M_2) over vermi compost (M_3), FYM (M_1) and no application (M_0) of organic manures could be because of better nutrient supply through out the cropping period and also might be due to the better aggregate formation in soil. Another reason might be increase in yield attributes such as number and length of spikes and number of capsules per spike due to the application of 5 t bio compost/ha over no manure. Application of vermi compost and FYM though produced positive effect over control but, failed to increase the seed yield might be due to the different rate of application and quantity of nutrients supplied through them. Significantly 84 and 49 per cent higher castor seed and stalk yields were registered at 100 per cent RDF along with 5 t bio compost/ha (M_2F_3) over the treatment combinations M_1F_0 and M_0F_0, respectively. This was possible due to the improvement in all the growth and yield attributes which might have generated a cumulative effect on seed yield. Another reason might be due to the additive effect of bio compost which might be possible because of better soil condition, mineralization of essential plant nutrients, addition of micronutrients in the soil, the enhanced activities of microbes and release of growth stimulants (enzymes) due to the increased activities of microorganisms. Similar results were also reported by Arangarasan *et al.* (1999) and Laxminarayana (2004).

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